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TITLE: Clinical Trial of a Comprehensive Treatment for High-Functioning Children with ASD

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14. ABSTRACT The purpose of this RCT is to test the efficacy of an outpatient psychosocial treatment (MAXout) on the ASD symptoms and social-communicative functioning of 7-12 year olds with HFASD. The treatment targets social/social-communication skills, non-literal language skills, emotion-decoding skills, and interest expansion. Treatment is delivered over 18 weeks (two 90 min. sessions/wk.) with each treatment group consisting of 4 children with HFASD and 2 staff clinicians. Treatment efficacy is assessed immediately following the 18-week treatment and 4-6 weeks post-treatment. Following year 2, significant progress has been made in regard to the major activities/objectives which included: (1) renewal and completion of the regulatory review; (2) implementation of the treatment for sampling wave 2; (3) completion of pretest, posttest, and follow-up measures for sampling wave 2; (4) enrollment of sampling wave 3; (5) recruitment and training of staff clinicians and research assistants; (6) implementation of the treatment for sampling wave 3; (7) completion of pretest, posttest, and follow-up measures for sampling wave 3; (8) enrollment of sampling wave 4; and (9) recruitment and training of staff clinicians and research assistants for wave 4. Per the SOW, all of these were completed in year 2.					
15. SUBJECT TERMS High-functioning children with ASD, outpatient treatment, comprehensive psychosocial treatment, MAXout, group-based treatment					
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1. INTRODUCTION

This RCT is testing the efficacy of an outpatient comprehensive psychosocial treatment (MAXout) on the ASD symptoms and social-communicative functioning of 7-12 year olds with HFASD. The manualized treatment targets social/social-communication skills, interpretation of non-literal language skills, emotion-decoding skills, and interest expansion. Treatment is delivered over 18 weeks (two 90 min. sessions/wk.) with each treatment group consisting of 4 children with HFASD and 2 staff clinicians. The protocol utilizes direct instruction, modeling, role-play (rehearsal), performance feedback (reinforcement), transfer of learning, and repeated practice to foster skills acquisition and maintenance and reduce ASD symptoms. Treatment efficacy is assessed immediately following the 18-week treatment and 4-6 weeks post-treatment.

2. KEYWORDS

High-functioning children with ASD, outpatient treatment, comprehensive psychosocial treatment, MAXout, group-based treatment

3. ACCOMPLISHMENTS

Major goals of the project

Per the approved SOW, this single-site RCT is being conducted to evaluate the efficacy of the innovative outpatient comprehensive psychosocial treatment (MAXout) on the ASD symptoms and social-communicative functioning of 7-12 year olds with HFASD compared to control (waitlist) children with HFASD.

Accomplishments under the goals

Per the SOW, the major activities and objectives for year 2 involved: (1) renewal and completion of the regulatory review; (2) implementation of the treatment for sampling wave 2; (3) completion of pretest, posttest, and follow-up measures for sampling wave 2; (4) enrollment of sampling wave 3; (5) recruitment and training of staff clinicians and research assistants; (6) implementation of the treatment for sampling wave 3; (7) completion of pretest, posttest, and follow-up measures for sampling wave 3; (8) enrollment of sampling wave 4; and (9) recruitment and training of staff clinicians and research assistants for wave 4. The following is a description of progress per each of these activities/objectives.

Renewal and regulatory review

The local IRB renewed the protocol on Jun 21, 2017; there was no lapse in approval. The local IRB approval letter, local IRB renewal packet, and HRPO Continuing Review Submission Form were submitted to the HRPO on Jun 23, 2017 and were approved by the HRPO via email

dated Jul 5, 2017 (from N E Englar). **Per the SOW for year 2, all regulatory tasks were completed as proposed.**

Implementation and completion of the treatment protocol for sampling wave 2

As proposed, the children with HFASD randomly assigned to the treatment group completed the 18-week treatment protocol (1 child withdrew from treatment). The treatment groups consisted of 4 children with HFASD and 2 staff clinicians. Treatment was delivered during two 90-minute sessions per week, with each 90-minute session consisting of two 45-minute treatment cycles. Each treatment cycle included 15-minutes of skills instruction followed by a 30-minute therapeutic activity designed to practice the skills learned in the skills instruction. The treatment cycles targeted social/social-communication skills, facial emotion recognition skills, non-literal language skills, and interest expansion using direct instruction, modeling, role-play/rehearsal, performance feedback/reinforcement, and transfer of learning. A structured response-cost point system and individualized daily note (IDN) were also used to promote and strengthen skills acquisition and maintenance and reduce ASD symptoms and problem behaviors. Response-cost and IDN feedback were provided throughout the sessions by the staff clinicians and each child could earn an on-site reward, as well as a reinforcer at home for reaching an individualized target level of performance.

Fidelity was monitored throughout treatment implementation by research assistants uninvolved with treatment delivery, through one-way-mirrored observation rooms. A total of 64% of the sessions (randomly selected) were observed for fidelity and fidelity was 95% for skills groups and 97% for the therapeutic activities. A total of 37% of the observations were conducted simultaneously by a second rater to monitor the reliability of the observers; overall IOA was 98% across the individual treatment elements/steps. Information was also collected from parents of children on the waitlist during the period that the treatment children were receiving treatment (parent reported support services/therapeutic programming, traumatic events, and medication status/changes). **Per the SOW, all activities/objectives involving implementation and completion of the treatment protocol for sampling wave 2 were completed.**

Completion of pretest, posttest, and follow-up measures for sampling wave 2

All pretest, posttest, and follow-up measures were completed for the children that completed wave 2. This included parent ratings of the children using the Social Responsiveness Scale, Second Edition, School Age Form (SRS-2; Constantino & Gruber, 2012) and the Adapted Skillstreaming Checklist (ASC; Lopata, Thomeer, et al., 2008; 2010). In addition, all of the children were video-recorded interacting with another peer with HFASD; these recordings have been coded by naïve raters using the Social Interaction Observation Scale (SIOS; Bauminger, 2002). **Per the SOW, all pretest, posttest, and follow-up measures were completed for sampling wave 2.**

Recruitment and enrollment of sampling wave 3

The targeted and enrolled sample size for wave 3 was $n = 16$ children with HFASD. Written parental consent and written child assent were obtained for all participants that completed screening (screening consent/assent), as well as for those that qualified and were

enrolled in the treatment trial (treatment consent/assent). These 16 children with HFASD were randomly assigned to the treatment or waitlist control groups (i.e., $n = 8$ children with HFASD in the treatment condition [4 children with HFASD in each of the 2 treatment groups] and $n = 8$ children with HFASD in the waitlist control condition). **Per the SOW, the recruitment and enrollment of sampling wave 3 was completed as proposed.**

Recruitment and training of staff clinicians and research assistants for wave 3

As proposed, 1 clinical supervisor was recruited, 8 staff clinicians were recruited and trained to implement the protocol, and 2 research assistants were recruited to conduct assessments and assess fidelity for sampling wave 3. Each of the staff clinicians passed a written exam testing her/his mastery of the treatment manual (score of 100% required), completed the training, and demonstrated $\geq 90\%$ accuracy (fidelity) administering the protocol prior to initiation of treatment. In addition to conducting assessments and assisting with data management, each of the research assistants was trained in the use of the standardized fidelity forms and was required to demonstrate $> 90\%$ reliability (inter-observer agreement [IOA]) using the fidelity forms prior to conducting fidelity observations as part of the study. Lastly, 2 behavioral coders were recruited to code the video-recordings of the children's interactions. Each was required to establish IOA prior to the initiation of actual coding and each remained naïve to the treatment condition of the children in the recordings. **Per the SOW, the recruitment and training of staff clinicians and research assistants for sampling wave 3 was completed as proposed.**

Implementation and completion of the treatment protocol for sampling wave 3

As proposed, the children with HFASD randomly assigned to the treatment group completed the 18-week treatment protocol (1 child withdrew from the waitlist control group). The treatment groups consisted of 4 children with HFASD and 2 staff clinicians. Treatment was delivered during two 90-minute sessions per week, with each 90-minute session consisting of two 45-minute treatment cycles. Each treatment cycle included 15-minutes of skills instruction followed by a 30-minute therapeutic activity designed to practice the skills learned in the skills instruction. The treatment cycles targeted social/social-communication skills, facial emotion recognition skills, non-literal language skills, and interest expansion using direct instruction, modeling, role-play/rehearsal, performance feedback/reinforcement, and transfer of learning. A structured response-cost point system and individualized daily note (IDN) were also used to promote and strengthen skills acquisition and maintenance and reduce ASD symptoms and problem behaviors. Response-cost and IDN feedback were provided throughout the sessions by the staff clinicians and each child could earn an on-site reward, as well as a reinforcer at home for reaching an individualized target level of performance.

Fidelity was monitored throughout treatment implementation by research assistants uninvolved with treatment delivery, through one-way-mirrored observation rooms. A total of 63% of the sessions (randomly selected) were observed for fidelity and fidelity was 97% for skills groups and 97% for the therapeutic activities. A total of 45% of the observations were conducted simultaneously by a second rater to monitor the reliability of the observers; overall IOA was 99% across the individual treatment elements/steps. Information was also collected from parents of children on the waitlist during the period that the treatment children were

receiving treatment (parent reported support services/therapeutic programming, traumatic events, and medication status/changes). **Per the SOW, all activities/objectives involving implementation and completion of the treatment protocol for sampling wave 3 were completed.**

Completion of pretest, posttest, and follow-up measures for sampling wave 3

All pretest, posttest, and follow-up measures were completed for the children that completed wave 3. This included parent ratings of the children using the Social Responsiveness Scale, Second Edition, School Age Form (SRS-2; Constantino & Gruber, 2012) and the Adapted Skillstreaming Checklist (ASC; Lopata, Thomeer, et al., 2008; 2010). In addition, all of the children were video-recorded interacting with another peer with HFASD; these recordings are being coded by naïve raters using the Social Interaction Observation Scale (SIOS; Bauminger, 2002). **Per the SOW, all pretest, posttest, and follow-up measures were completed for sampling wave 3.**

Recruitment and enrollment of sampling wave 4

The targeted and enrolled sample size for wave 4 was $n = 16$ children with HFASD. Written parental consent and written child assent were obtained for all participants that completed screening (screening consent/assent), as well as for those that qualified and were enrolled in the treatment trial (treatment consent/assent). These 16 children with HFASD were randomly assigned to the treatment or waitlist control groups (i.e., $n = 8$ children with HFASD in the treatment condition [4 children with HFASD in each of the 2 treatment groups] and $n = 8$ children with HFASD in the waitlist control condition). **Per the SOW, the recruitment and enrollment of sampling wave 4 was completed as proposed.**

Recruitment and training of staff clinicians and research assistants for wave 4

As proposed, 1 clinical supervisor was recruited, 8 staff clinicians were recruited and trained to implement the protocol, and 2 research assistants were recruited to conduct assessments and assess fidelity for sampling wave 4. Each of the staff clinicians passed a written exam testing her/his mastery of the treatment manual (score of 100% required), completed the training, and demonstrated $\geq 90\%$ accuracy (fidelity) administering the protocol prior to initiation of treatment. In addition to conducting assessments and assisting with data management, each of the research assistants was trained in the use of the standardized fidelity forms and was required to demonstrate $> 90\%$ reliability (inter-observer agreement [IOA]) using the fidelity forms prior to conducting fidelity observations as part of the study. Lastly, 1 behavioral coder was recruited and the second behavioral coder will be recruited to begin coding the video-recordings of the children's interactions in fall 2017. Each will be required to establish IOA prior to the initiation of actual coding and each will remain naïve to the treatment condition of the children in the recordings. **Per the SOW, the recruitment and training of staff clinicians and research assistants for sampling wave 4 was completed as proposed** (with the exception of the behavioral coders who will begin in fall 2017).

Opportunities for training and professional development provided by project

Although this project is not intended to provide training and professional development opportunities, a number of opportunities are inherent in the project activities including the enhancement of knowledge, skills, and proficiency of undergraduate and graduate students, as well as parents of children with HFASD participating in the trial. These opportunities were afforded to these individuals as a function of their involvement in the evaluation of the outpatient treatment (MAXout) (e.g., intervention implementation, fidelity monitoring, assessment, data management, parent training).

In this study, undergraduate and graduate students serve as staff clinicians (delivering the manualized treatment), research assistants, behavioral coders, and the research clinician supervisor. These students receive extensive training in autism spectrum disorder/HFASD, the current state of treatments for HFASD, the empirical basis of the MAXout framework, administration of the MAXout protocol, and effective fidelity monitoring. Depending on their position, they spend considerable time prior to the intervention practicing and demonstrating proficiency ($\geq 90\%$ fidelity) implementing all components of the treatment, or establishing IOA measuring fidelity or coding behaviors. The undergraduate and graduate students also receive training in the administration and scoring of several outcome measures, as well as in data management and monitoring of data accuracy. Lastly, parents of children with HFASD in the active treatment condition participate in parent training. These parent training sessions educate parents on the components of the program, and strategies for reducing ASD symptoms and promoting skills and generalization. All of these training opportunities were provided and/or supported by the study coordinator, developers of the MAXout protocol, and/or data manager and they will continue to be offered over the course of the study.

Dissemination of results to communities of interest

Nothing to report involving dissemination of results (i.e., outcomes). To date, outreach activities have been undertaken mainly to share information about the project with clinical practitioners and school administrators/staff that would not ordinarily be aware of such research activities. Sharing this information about the project has increased public knowledge of the project, as well as assisted with recruitment of participants.

Plans for accomplishing project goals in next reporting period

For the next reporting period, we anticipate accomplishing all goals/objectives according to the timeline delineated in the SOW. The project is on-schedule and we do not anticipate any changes to the proposed timeline for the upcoming quarters or annual reporting period.

4. IMPACT

Impact of the project on development of the principal discipline(s)

Nothing to report at this point on treatment efficacy. The study is evaluating the efficacy of a comprehensive outpatient psychosocial treatment (MAXout) for children with HFASD. At present, little is known about how to effectively and robustly increase the social and communication skills, and reduce the ASD symptoms of these children in an outpatient format. This subgroup of children with ASD has received limited treatment research attention and their impairments pose a significant challenge to clinical and educational professionals, and parents. Findings from this study will likely impact the fields of psychology and psychiatry. Empirical support for the MAXout program will provide clinical professionals with a clearly-defined and manualized treatment protocol (instructional techniques, content, and progress monitoring measures) for use in clinical outpatient settings. In addition, the comprehensive intervention in this study (MAXout) is an adaptation of another evidence-based psychosocial treatment for children with HFASD that is delivered in a summer program format (summerMAX). Support for the MAXout and summerMAX programs will allow flexibility in the manner in which public resources may be directed or the delivery format of the critical elements in the programs (outpatient or summer program delivery).

Impact on other disciplines. Nothing to report

Impact on technology transfer. Nothing to report

Impact on society beyond science and technology

No conclusions on efficacy are yet available however preliminary results (from the pilot study) suggested positive effects of the treatment on several targeted areas (e.g., social-communication skills, ASD symptoms, etc.). Although final results are not yet available, support for the MAXout treatment protocol may impact the social conditions and outcomes for individuals with HFASD. Findings of other studies have indicated that individuals with HFASD experience long-term challenges that limit their independence and ability to maintain employment, leading to prolonged dependence on family members and societal resources. Improving the social-communication skills and ASD symptoms of children with HFASD may impact future adaptive functioning, and allow career- and vocational-development programs to yield greater successes.

5. CHANGES/PROBLEMS

Changes in approach and reasons for change. Nothing to report (study is progressing as originally proposed)

Problems or delays and actions or plans to resolve them. Nothing to report

Changes that significantly impacted expenditures. Nothing to report

Significant changes in use or care of human subjects. Nothing to report

6. PRODUCTS

Publications (articles, books), conference papers, and presentations.

Peer-reviewed article

Lopata, C., Rodgers, J. D., Donnelly, J. P., Thomeer, M. L., McDonald, C. A., & Volker, M. A. (2017). Psychometric properties of the Adapted Skillstreaming Checklist for high-functioning children with ASD. *Journal of Autism and Developmental Disorders*. doi: 10.1007/s10803-017-3189-y [acknowledgement of federal support – YES] Copy of article included in Appendix

Website(s) or other internet site(s). Nothing to report

Technologies or techniques. Nothing to report

Inventions, patent applications, and/or licenses. Nothing to report

Other products. Nothing to report

7. PARTICIPANTS AND OTHER COLLABORATING ORGANIZATIONS

Individuals who have worked on project

Name:	Christopher Lopata
Project role:	PD/PI
Nearest person month worked:	4*
Contribution to project:	No change
	* Lopata's academic year effort was increased by 1 month due to covering Thomeer's effort while Thomeer was on sabbatical (this was approved by our program officer and the DoD representative)

Funding support:

Name:	Marcus L Thomeer
Project role:	Co-PI
Nearest person month worked:	2*
Contribution to project:	No change

* Thomeer's academic year effort was decreased by 1 month due to being on sabbatical (this was approved by our program officer and the DoD representative)

Funding support:

Name:	James P Donnelly
Project role:	Co-PI
Nearest person month worked:	3
Contribution to project:	No change
Funding support:	

Name:	Jonathan D Rodgers
Project role:	Co-PI
Nearest person month worked:	7 (calendar)
Contribution to project:	No change
Funding support:	

Name:	Rachael Kapuscinski
Project role:	Graduate Assistant
Nearest person month worked:	5 (waves 2 and 3)
Contribution to project:	Assisted with recruitment and screening, conducted assessments, conducted fidelity checks and ensured fidelity assessments were completed, monitored protocol returns, checked and scored protocols, loaded data, and conducted checks for data accuracy. Also assisted with treatment implementation and staff training and supervision as needed.
Funding support:	

Name:	Adam Booth
Project role:	Staff Clinician Supervisor (waves 2 and 3)
Nearest person month worked:	3
Contribution to project:	Supervised the staff clinicians, ensured fidelity assessments were completed, followed-up with parents on paperwork as needed, and oversaw all treatment

provision and interactions between staff clinicians and parents.

Funding support:

Name:	Mary Russo
Project role:	Staff Clinician (waves 2 and 3)
Nearest person month worked:	3
Contribution to project:	Successfully completed the training program, established fidelity with the protocol, assisted with materials preparation, and implemented the 18-week outpatient treatment to groups of children with HFASD according to the manualized protocol.

Funding support:

Name:	Natalie Couse
Project role:	Staff Clinician (waves 2 and 3)
Nearest person month worked:	3
Contribution to project:	Successfully completed the training program, established fidelity with the protocol, assisted with materials preparation, and implemented the 18-week outpatient treatment to groups of children with HFASD according to the manualized protocol.

Funding support:

Name:	Audrey Holt
Project role:	Staff Clinician (waves 2 and 3)
Nearest person month worked:	3
Contribution to project:	Successfully completed the training program, established fidelity with the protocol, assisted with materials preparation, and implemented the 18-week outpatient treatment to groups of children with HFASD according to the manualized protocol.

Funding support:

Name:	Elizabeth Pittari
Project role:	Staff Clinician (waves 2 and 3)
Nearest person month worked:	3
Contribution to project:	No change
Funding support:	

Name:	Samantha Stanford
Project role:	Research Assistant (wave 2); Staff Clinician (wave 3)
Nearest person month worked:	3
Contribution to project:	Assisted with preparation of assessment materials and assessments, conducted fidelity checks, monitored the status of protocol returns and followed-up on missing protocols/items, checked and scored protocols, loaded data, and conducted checks for data accuracy.
	Successfully completed the training program, established fidelity with the protocol, assisted with materials preparation, and implemented the 18-week outpatient treatment to groups of children with HFASD according to the manualized protocol.
Funding support:	

Name:	Zoe Gionis
Project role:	Staff Clinician (wave 2)
Nearest person month worked:	1
Contribution to project:	Successfully completed the training program, established fidelity with the protocol, assisted with materials preparation, and implemented the 18-week outpatient treatment to groups of children with HFASD according to the manualized protocol.
Funding support:	

Name:	Cody Kucharski
Project role:	Staff Clinician (wave 2)

Nearest person month worked: 1
Contribution to project: Successfully completed the training program, established fidelity with the protocol, assisted with materials preparation, and implemented the 18-week outpatient treatment to groups of children with HFASD according to the manualized protocol.

Funding support:

Name: Megan Stoll
Project role: Staff Clinician (wave 3)
Nearest person month worked: 1
Contribution to project: Successfully completed the training program, established fidelity with the protocol, assisted with materials preparation, and implemented the 18-week outpatient treatment to groups of children with HFASD according to the manualized protocol.

Funding support:

Name: Jane Grucella
Project role: Staff Clinician (wave 3)
Nearest person month worked: 1
Contribution to project: Successfully completed the training program, established fidelity with the protocol, assisted with materials preparation, and implemented the 18-week outpatient treatment to groups of children with HFASD according to the manualized protocol.

Funding support:

Name: Allan Chadwick LaFlore
Project role: Staff Clinician (wave 3)
Nearest person month worked: 1
Contribution to project: Successfully completed the training program, established fidelity with the protocol, assisted with materials preparation, and implemented the 18-week

outpatient treatment to groups of children with HFASD according to the manualized protocol.

Funding support:

Name:	Natalie Ryan
Project role:	Research Assistant (wave 2)
Nearest person month worked:	1
Contribution to project:	Assisted with preparation of assessment materials and assessments, conducted fidelity checks, monitored the status of protocol returns and followed-up on missing protocols/items, checked and scored protocols, loaded data, and conducted checks for data accuracy.

Funding support:

Name:	Mary-Lynn McHugh
Project role:	Research Assistant (wave 3)
Nearest person month worked:	1
Contribution to project:	Assisted with preparation of assessment materials and assessments, conducted fidelity checks, monitored the status of protocol returns and followed-up on missing protocols/items, checked and scored protocols, loaded data, and conducted checks for data accuracy.

Funding support:

Name:	Mara Bengry
Project role:	Research Assistant (wave 3)
Nearest person month worked:	1
Contribution to project:	Assisted with preparation of assessment materials and assessments, conducted fidelity checks, monitored the status of protocol returns and followed-up on missing protocols/items, checked and scored protocols, loaded data, and conducted checks for data accuracy.

Funding support:

Name:	Megan Mathewson
Project role:	Behavioral Coder (waves 2 and 3)
Nearest person month worked:	3
Contribution to project:	Completed training, established inter-observer agreement prior to and during actual coding, and coded the video recordings according to the operational definitions and manualized procedures. Also assisted with management of de-identified data.

Funding support:

Name:	Katelynn Eck
Project role:	Behavioral Coder (waves 2 and 3)
Nearest person month worked:	3
Contribution to project:	Completed training, established inter-observer agreement prior to and during actual coding, and coded the video recordings according to the operational definitions and manualized procedures. Also assisted with management of de-identified data.

Funding support:

Changes in other support of the PD/PI(s) or senior/key personnel since last reporting period.
Nothing to report

Other organizations involved as partners. Nothing to report

8. SPECIAL REPORTING REQUIREMENTS

None

9. APPENDIX

Peer-reviewed article included:
Lopata, C., Rodgers, J. D., Donnelly, J. P., Thomeer, M. L., McDonald, C. A., & Volker, M. A. (2017). Psychometric properties of the Adapted Skillstreaming Checklist for high-functioning children with ASD. *Journal of Autism and Developmental Disorders*. doi: 10.1007/s10803-017-3189-y

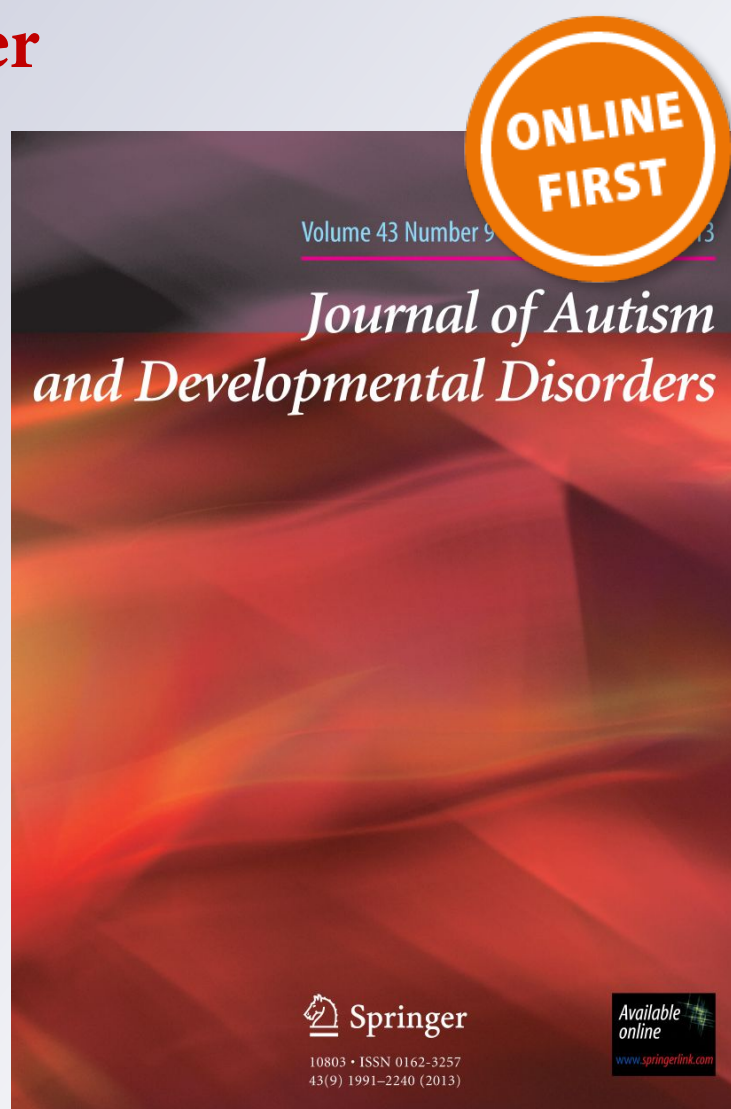
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Psychometric Properties of the Adapted Skillstreaming Checklist for High-functioning Children with ASD

Christopher Lopata¹ · Jonathan D. Rodgers¹ · James P. Donnelly¹ ·
Marcus L. Thomeer¹ · Christin A. McDonald¹ · Martin A. Volker²

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Abstract This study examined the reliability and criterion-related validity of parent ratings on the Adapted Skillstreaming Checklist (ASC) for a sample of 275 high-functioning children, ages 6–12 years, with ASD. Internal consistency for the total sample was 0.92. For two subsamples, test–retest reliability was very good at the 6-week and good at the 9-month intervals. Child age, IQ, and language abilities were unrelated to the ASC score. The ASC total score was inversely and strongly related to parent ratings of ASD symptom severity. Significant positive correlations (moderate-to-high) were found between the ASC and prosocial skills scales and significant negative correlations (low-to-moderate) with problem behavior scales on a broad measure of child functioning. Implications and suggestions for future study are discussed.

Keywords Adapted Skillstreaming Checklist · Parent ratings · Psychometric properties · High-functioning children with ASD

Introduction

Autism spectrum disorder (ASD) is characterized by a complex constellation of clinical features including social/social-communication deficits and circumscribed and

repetitive behaviors and interests (APA 2013). Developing measures to assess the clinical features and performance of children with ASD is a challenge given significant heterogeneity in functional levels and the fact that cognitive, language, and developmental levels can affect the manner in which features are exhibited and the properties of assessment measures (Koenig et al. 2009; Lord and Corsello 2005; Lord et al. 2014). The implication of such factors strongly suggests the need for measures that are developed and evaluated for narrower subgroups with ASD (Lord et al. 2014). One such subgroup is high-functioning children with ASD (HFASD). This group is characterized by the core diagnostic features, but differentiated based on relatively intact and relative strengths in cognitive and language functioning (APA 2013).

The recent substantial increase in the prevalence of children with HFASD (i.e., without concomitant intellectual disability; CDC 2014) strongly indicates the need for instruments that efficiently yield information on the clinical features and skills of these children and the effectiveness of treatments. Diagnostic observations and interviews yield accurate diagnoses, however they are often impractical in clinical settings (schools, clinics, etc.) because they require a high degree of training and experience, and are time and labor intensive (Norris and Lecavalier 2010). Further, they are often limited by their dichotomous assessment of symptoms and behaviors (i.e., absent or present) and they do not yield information on the degree of impairment or the extent to which a skill/behavior is exhibited (Achenbach 2011). This has generally rendered them ineffective for monitoring treatment progress or assessing outcomes. This is not surprising as they were not developed to measure change and do not possess psychometric data to support such use (Lord et al. 2014).

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Rating scales are another type of measure commonly used to gather information on the clinical features and skills of children with HFASD/ASD. Advantages associated with rating scales include the fact that they are brief, simple to administer, economical, and based on informants in authentic settings, can be completed by different informants (Constantino and Gruber 2012; Norris and Lecavalier 2010), and have the capacity to assess a range of skills, behaviors, and symptoms (Lord and Corsello 2005). In addition, many utilize continuous scaling (Achenbach 2011; Reynolds and Kamphaus 2015) which is consistent with the diagnostic framework that characterizes ASD features/impairments on a continuum of severity (APA 2013). Continuous scaling also provides information on the degree to which a skill/behavior is exhibited and/or the severity of impairment (Achenbach 2011; Gadow et al. 2006). Another advantage to rating scales is that they can be keyed to diagnostic criteria (Gadow et al. 2006), thus yielding information involving features of ASD (Lord and Corsello 2005).

One final area of potential benefit involves the use of rating scales as an outcome measure. Continuous scaling makes rating scales useful as indicators of treatment response and outcomes (Achenbach 2011; Reynolds and Kamphaus 2015) including for ASD-related scales (Constantino and Gruber 2012). Identifying measures that yield information on the skills, behaviors, and/or symptoms of ASD and that are treatment sensitive continues to be a challenge and many authors have noted the lack of treatment sensitive measures, the negative effect of this on determining treatment efficacy, and the need for such measures (e.g., Bellini et al. 2014; Koenig et al. 2009; Reichow and Volkmar 2010; Smith et al. 2007; White et al. 2007). Treatment sensitivity may be low if the rating scale items are not aligned with the treatment targets (Koenig et al. 2009), although this might be improved if the intervention targets and scale items are aligned with (keyed to) the clinical features of HFASD/ASD (White et al. 2007). The need for better alignment of treatment targets and outcome indicators has led to suggestions that investigators create and/or adapt measures unique to a given study (Kaat and Lecavalier 2014; Lord et al. 2005). To date, HFASD treatment researchers have created study-specific social-cognitive tests (e.g., Laugeson et al. 2012; Lopata et al. 2010) and rating scales (e.g., DeRosier et al. 2011) in an effort to increase treatment sensitivity, yet little is known about the broader psychometric properties of such measures and studies are needed.

The Adapted Skillstreaming Checklist (ASC) is a study-specific rating scale that was created by Lopata and Thomeer to assess outcomes of a psychosocial treatment for 7–12 year olds with HFASD (Lopata et al. 2008). The targets of the treatment program were selected to address the clinical features of HFASD and were keyed to specific

diagnostic elements (i.e., social/social-communication skills and restricted and repetitive behaviors/interests). Items on the ASC parallel the treatment targets and assess prosocial skills/behaviors aligned with the diagnostic features of children with HFASD. The ASC is comprised of items and adapted items from the Skillstreaming (Goldstein et al. 1997; McGinnis and Goldstein 1997) curriculum (a psychosocial intervention designed to teach prosocial skills to children lacking in such skills), along with researcher-developed items. Together the items assess social/social-communication skills and behavioral regulation and flexibility.

The ASC has exhibited good treatment sensitivity in multiple psychosocial treatment trials for children, ages 6–12 years, with HFASD; within-group (baseline-posttest) effect sizes ranging from medium (e.g., Lopata et al. 2008) to large (Lopata et al. 2017) for parent ratings. Despite good treatment sensitivity, sample-specific ASC psychometric data were described for only two of the treatment trials. Internal consistency reliability was 0.94 for both studies ($N=54$ parent ratings for Lopata et al. 2008 and $N=36$ parent ratings for Lopata et al. 2010). In addition, the authors reported correlations with scales on the Behavior Assessment System for Children (BASC)/BASC-2 (Reynolds and Kamphaus 1992, 1998, 2004). Correlations between the ASC total score parent ratings and BASC/BASC-2 social skills scores were 0.72 and 0.66, and leadership scores were 0.62 and 0.66, respectively (Lopata et al. 2008, 2010). In addition, the ASC correlated 0.79 with the adaptive skills composite (Lopata et al. 2010) and -0.45 with the withdrawal scale score (Lopata et al. 2008). The authors characterized these as basic evidence supporting the reliability and criterion-related validity of the ASC. Despite these initial indications, the psychometric data were based on small samples of parent ratings. In addition, the ASC was not compared against a measure of ASD-related clinical features (i.e., impairments). This is of particular interest given that the ASC was keyed to skills that reflect improvements in parallel ASD-related dimensions.

This study was conducted to assess the psychometric properties of the ASC using a large sample of parent ratings from multiple treatment trials. Given the impact of functional level on measure properties, it addresses the need for psychometric evaluation of ASD-related scales in carefully-characterized samples and more narrowly-defined subgroups (i.e., HFASD; Lord and Corsello 2005; Lord et al. 2014; Norris and Lecavalier 2010). Rigorous testing is especially warranted for researcher-developed instruments created for a specific study, as well as for measures that exhibit treatment sensitivity. According to White et al. (2007), “[t]he utility of new or adapted outcome measures should be evaluated for reliability and validity” (p. 1867). This study examined the (1) internal consistency and

stability (short- and long-term test–retest reliability) of the ASC; and (2) criterion-related validity against other established prosocial and ASD-impairment scales for a large sample of parent ratings of children with HFASD. The data used in this study were unique and not part of the studies or data reported by Lopata et al. (2008, 2010) in their preliminary psychometric information on the ASC.

Methods

Participants

A total of 275 parent ratings of children, ages 6–12 years, with HFASD were included in the analyses. Data were compiled from multiple prior clinical trials evaluating the efficacy of psychosocial treatments for children with HFASD. Children in those trials were recruited using public and school-based announcements. All of the children had a prior clinical diagnosis of ASD (or autism, Asperger's, or pervasive developmental disorder-not otherwise specified), Wechsler Intelligence Scale for Children-4th Edition (WISC-IV; Wechsler 2003) short-form IQ > 70, and Comprehensive Assessment of Spoken Language (CASL; Carrow-Woolfolk 1999) short-form expressive or receptive language score > 70. All children also met criteria on the Autism Diagnostic Interview-Revised (Rutter et al. 2003) or Social Communication Questionnaire (Rutter et al. 2003), which was completed to verify their diagnosis.

The child sample for the current study was predominantly male (90.2%) and Caucasian (89.1%), with a mean IQ and language level in the average range. Average reported parent education of the parent raters was 15.76 years (Table 1).

Measures

Adapted Skillstreaming Checklist (ASC)

The ASC (Lopata et al. 2008) is a 38-item rating scale originally created by Lopata and Thomeer to measure social/social-communication skills and behaviors targeted in a summer psychosocial treatment program for children with HFASD. Each of the scale items measures a specific treatment target (skill/behavior) and is keyed to a clinical feature of HFASD. The scale consists of 30 items (including adapted items) from the Skillstreaming curriculum (Goldstein et al. 1997; McGinnis and Goldstein 1997) and eight researcher-created items. Across the 38-items, 32 assess social/social-communication skills and six assess behavioral regulation and flexibility. Each item is rated on a scale ranging from 1 (almost never) to 5 (almost always). Individual items are summed to yield a total composite score

Table 1 Demographic characteristics of child sample and parent raters

Characteristic	Child participants ($N = 275$) M (SD)
Age (years)	9.26 (1.63)
Parent education (years)	15.76 (2.19)
WISC-IV short-form IQ	105.14 (14.32)
CASL	
Short-form expressive language	99.76 (15.57)
Short-form receptive language	104.74 (16.22)
ADI-R	
Impairment in social interaction	18.79 (5.47) ^a
Impairment in communication	15.20 (4.34) ^a
Restricted repetitive behavior	5.90 (2.10) ^a
SCQ total score	21.35 (5.58) ^b
	n (% of total)
Gender	
Male	248 (90.2)
Female	27 (9.8)
Ethnicity	
Caucasian	245 (89.1)
African-American	7 (2.5)
Latino	3 (1.1)
Asian-American	4 (1.5)
Mixed race/ethnicity	16 (5.8)

The WISC-IV 4-subtest short-form consisted of the block design, similarities, vocabulary, and matrix reasoning subtests and the CASL 4-subtest short form consisted of the antonyms, synonyms, syntax construction, and paragraph comprehension subtests

WISC-IV Wechsler Intelligence Scale for Children-4th Edition, CASL Comprehensive Assessment of Spoken Language, ADI-R Autism Diagnostic Interview-Revised, SCQ Social Communication Questionnaire

^aADI-R scores M and SD based on a sample size of $n = 215$

^bSCQ total score M and SD based on a sample size of $n = 60$

and higher total scores indicate greater use of the prosocial/adaptive skill/behavior. (preliminary data on the psychometric properties of the ASC were described in the Introduction).

Social Responsiveness Scale, Second Edition (SRS-2)

The SRS-2 (Constantino and Gruber 2012) is an objective measure of ASD-associated symptoms. The School-Age Form (ages 4–18 years) consists of 65 items that assess ASD clinical features involving interpersonal behavior, communication, and stereotypic and circumscribed behaviors and interests on a continuous scale. Parents rate the frequency of behaviors on a scale of 1 (not true) to 4 (almost always true). Individual items are summed and converted to a total composite standard score ($M = 50$, $SD = 10$), with

higher scores indicative of greater ASD-associated symptom severity/impairments. The total score has internal consistency estimates of 0.95–0.96 for the parent reports (for ages 6–12 years). Data in the test manual indicate moderate-to-high correlations with other ASD measures, and that the SRS-2 accurately discriminates individuals with ASD from typically-developing individuals and individuals with other disorders (Constantino and Gruber 2012). Although factor analytic data found that the majority of items were assessing one ASD trait (*SCI* social communication and interaction), a subset of items reportedly indicated a second trait (*RRB* restricted interests and repetitive behavior). According to Constantino and Gruber (2012), these findings support the total score as a valid index of severity, as well as the derivation of two index scores (*SCI* and *RRB*) that map onto the two ASD diagnostic criteria dimensions (APA 2013).

Behavior Assessment System for Children, Second Edition/Third Edition, Parent Rating Scales (BASC-2/3 PRS)

The BASC-2/3 PRS (Reynolds and Kamphaus 2004, 2015) assess a range of adaptive (prosocial) skills and clinical symptoms to assist with differential diagnosis, treatment planning, and progress monitoring. Items are rated on a 4-point frequency scale ranging from 0 (Never) to 3 (Almost always). Item scores are summed and converted to standard scores ($M=50$, $SD=10$). For the adaptive skills composite/scales, higher scores indicate more adaptive and prosocial skills and for the clinical composites/scales, higher scores represent more problematic symptoms/behaviors.

This study utilized the adaptive skills composite (and its constituent scales including adaptability, social skills, leadership, activities of daily living, and functional communication) and the externalizing problems composite (and its constituent scales including hyperactivity, aggression, and conduct problems). Internal consistency reliability estimates for the composites used in this study ranged from 0.95 to 0.97 for the adaptive skills composite (and from 0.76 to 0.92 for the individual adaptive scales) and from 0.93 to 0.96 for the externalizing problems composite (and from 0.79 to 0.91 for the individual externalizing scales). The developmental social disorders (DSD) content scale was also included as it assesses impairments in social and communication skills, and interests and activities associated with ASD. Internal consistency reliability for the DSD scale ranged from 0.82 to 0.91. Validity evidence is presented in factor analytic data supporting the derivation of scales, as well as in high intercorrelations among scales within the same composite. Concurrent validity is supported in moderate-to-high correlations between the BASC-2/3 composites

and scales and comparable composites and scales on other established rating scales (Reynolds and Kamphaus 2004, 2015). These composites and scales were included because they assess prosocial and adaptive skills/behaviors, problems associated with behavioral regulation/rigidity, and ASD features that are related to the skills assessed by the ASC.

Procedures

Each of the study protocols for the psychosocial treatment trials from which the cases were compiled was approved by the Institutional Review Board and executed according to the approved procedures, including attainment of informed consent and assent. In each of the treatment trials, parents completed a battery of pretest (baseline) and posttest measures that included the ASC, as well as the SRS-2 and BASC-2/3. Once completed and returned, each rating scale was immediately reviewed to ensure it was complete. Any incomplete protocol or protocol containing errors (multiple responses to an item, omitted items, etc.) was immediately reviewed with the informant to correct the error. To ensure scoring accuracy, each ASC protocol was independently scored by two research assistants and any discrepancies were resolved by a third scorer. The SRS-2 and BASC-2/3 were scored using their respective computer scoring programs by research assistants. All demographic and protocol data were initially entered into the study database by a research assistant and independently checked by a second research assistant, with any discrepancies corrected by a third member of the research team.

Data Analysis Plan

Prior to estimation of reliability and validity coefficients, data quality and completeness was examined, followed by study of deviations from normality for all items. Complete data was available for all 275 cases. There were no instances of out-of-range values. Following the initial data review, the individual ASC item characteristics were examined. Full scale analysis included two forms of reliability that are important to ASD-related measures: internal consistency and stability over time (test–retest; Lord et al. 2014). Criterion-related validity was assessed by examining correlations between the ASC and measures of ASD-related symptoms/impairments (SRS-2 and BASC-2/3 DSD) and several prosocial and problem behavior scales from an established multi-dimensional rating scale (BASC-2/3).

Results

Item Analysis

Table 2 presents central tendency, variability, and distribution statistics for all items and the total score. The overall central tendency evident in the medians and means is close to the center of the scale. Twenty-nine of the 38 items have medians at the center point of the scale (3.0), while the remaining nine have a median of 2.0. Item distribution indicators, including standard deviations, skewness, and kurtosis are generally acceptable (AERA 2014; DeVellis 2003). The standard deviations are generally close to 1.0, and none are extremely high or low. The average skewness value for the 38 items was 0.06, and all were below 0.5. The average kurtosis value was 0.26. The largest kurtosis value was -0.69 , slightly beyond the level of 2 standard errors ($SE = 0.293$). This value was identified for two items including item 6 (becoming acquainted with new people independently) and item 28 (dealing with teasing in a constructive way). These items had otherwise acceptable psychometrics and were retained for full scale inclusion and analysis. Specifically, item 6 had a skewness value of 0.196 ($SE = 0.147$), mean of 2.62, SD of 1.14, and item-total correlation of 0.42. Item 28 had a skewness value of 0.301 ($SE = 0.147$), mean of 2.22, SD of 0.94, and item-total correlation of 0.41. Corrected item-total correlations for all items (correlation of item to total scale excluding itself) ranged from 0.30 to 0.66 with a mean of 0.47.

Internal Consistency and Test–Retest Reliability

Internal consistency for the full scale was examined via Cronbach's coefficient alpha. The coefficient for the full scale was 0.92. Two separate subsamples of untreated children with HFASD were tested at two time points: 6 weeks ($n = 29$), and 9 months ($n = 36$). Pearson correlations and intraclass correlation coefficients (ICCs) were calculated for both subsamples. The two coefficients were included because the correlation shows the degree of covariation over time, while the ICC provides an accurate measure of agreement in which the level of endorsement as well as covariation is accounted for. That is, the Pearson r shows covariation but would not reveal a systematic increase from the first to the second assessment. The correlation for the 6-week test–retest was 0.81, with an ICC of 0.78. The correlation for the 9-month retest was 0.63, with an ICC of 0.64.

Criterion-Related Validity

Table 3 presents validity correlations for the ASC total score with selected child characteristics, the SRS-2 total

score and scales, and the BASC-2/3 composites and scales. The correlations of the ASC total score with age, estimated IQ (WISC-IV), and receptive and expressive language (CASL) scales are all near zero, demonstrating independence of the ASC content from age and measured intellectual and language abilities. The strong negative correlations between the SRS-2 total score and the SCI scale are consistent with the direction expected. The moderate negative correlation with the SRS-2 RRB scale is also consistent with the direction expected, given the level of correspondence between ASC skills and restricted/repetitive behavior. Consistent patterns are also evident in the correlations with the BASC-2/3 composites and scales. The correlation of the adaptive skills composite with the ASC total was 0.75, reflecting convergence on the underlying prosocial skills construct in both measures. The scale correlations ranged from 0.47 for the activities of daily living scale to 0.64 for the social skills scale, again consistent with expectations. Similarly, low-to-moderate negative correlations with the externalizing problems composite and its component scales (-0.29 to -0.46) are indicative of construct validity of the ASC. Finally, as predicted a strong negative correlation (-0.67) was found with the DSD content scale of the BASC-2/3.

Discussion

There is a need for development and testing of scales that efficiently yield information on the skills/behaviors of children with ASD. Significant heterogeneity in functional levels of these children and the potential impact of functional level on psychometric properties indicates the need to study measures in more narrowly-defined and functionally-homogeneous samples including children with HFASD (Lord et al. 2014). Measures are also needed that are treatment sensitive as there is currently a dearth of scales that have exhibited treatment sensitivity (e.g., Bellini et al. 2014, etc.). Rating scales represent a potentially useful type of measure for assessing ASD symptoms and severity, prosocial skills, and/or adaptive behaviors due to their continuous scaling and capacity to assess the degree to which the skill/feature is exhibited (Constantino and Gruber 2012; Reynolds and Kamphaus 2015). These may be even more useful if the skills and adaptive behaviors and/or symptoms are keyed to the clinical dimensions of a disorder (Gadow et al. 2006). This study was conducted to assess the reliability and criterion-related validity of the ASC (Lopata et al. 2008), which has shown good treatment sensitivity in prior psychosocial treatment trials for children with HFASD.

The reliability of parent ASC total score ratings was tested for internal consistency and stability. Results indicated good internal consistency (0.92), which is consistent

Table 2 Item characteristics

Item	<i>Mdn</i>	<i>M</i>	<i>SD</i>	Skewness	Kurtosis	Corrected item-total <i>r</i>
1. Does your child listen when you or others talk to him/her? ^a	3.0	3.53	0.79	0.202	-0.217	0.53
2. Does your child begin conversations with other people? ^a	3.0	3.14	1.02	-0.036	-0.452	0.49
3. Does your child talk to others about things of interest to both of them? ^a	2.0	2.43	0.83	0.104	0.227	0.53
4. Does your child know how and when to ask questions of another person? ^a	3.0	2.81	0.89	0.012	0.328	0.57
5. Does your child let others know that he/she is grateful for favors, etc.? ^a	3.0	2.93	1.05	0.002	-0.384	0.51
6. Does your child become acquainted with new people on his/her own? ^a	3.0	2.62	1.14	0.196	-0.694	0.42
7. Does your child tell others that he/she likes something they have done? ^b	3.0	2.72	0.96	-0.056	-0.422	0.60
8. Does your child request assistance when he/she is having difficulty? ^a	3.0	3.28	0.98	-0.109	-0.601	0.46
9. Does your child carry out instructions from others quickly and correctly? ^a	3.0	2.61	0.84	0.029	0.089	0.46
10. Does your child contribute to discussions occurring in the environment?	3.0	2.63	0.92	0.189	-0.021	0.48
11. Does your child give assistance to adults who might need some assistance? ^b	3.0	2.76	1.00	0.038	-0.333	0.46
12. Does your child ignore distractions and remain focused on the task at hand?	2.0	2.25	0.99	0.462	-0.294	0.30
13. Does your child end conversations before leaving or beginning a new topic?	2.0	2.45	0.94	0.386	-0.096	0.31
14. Does your child take steps to become part of an ongoing activity or group? ^a	2.0	2.41	0.88	0.307	0.019	0.47
15. Does your child give assistance to other children who might need or want it? ^a	3.0	2.81	0.89	-0.089	0.219	0.53
16. Does your child acknowledge and accept complements from others? ^b	3.0	3.07	1.02	-0.105	-0.550	0.59
17. Does your child offer to share what he/she has with others? ^a	3.0	2.88	0.99	-0.038	-0.397	0.49
18. Does your child make verbal or written apologies for things said or done? ^b	3.0	3.00	1.05	-0.151	-0.439	0.51
19. Does your child recognize which emotions he/she has at different times? ^a	3.0	3.07	1.02	-0.222	-0.368	0.57
20. Does your child let others know which emotions he/she is feeling? ^a	3.0	2.93	1.02	0.007	-0.246	0.57
21. Does your child understand what other people are feeling? ^a	3.0	2.74	0.83	-0.142	0.173	0.66
22. Does your child show understanding of another person's feelings? ^b	3.0	2.71	0.84	-0.205	0.029	0.58
23. Does your child express anger without verbal or physical aggression? ^b	3.0	2.65	1.16	0.323	-0.628	0.32
24. Does your child try to understand someone else's anger without getting angry him/herself? ^a	2.0	2.47	1.01	0.479	-0.184	0.53
25. Does your child let others know that he/she cares about them? ^a	3.0	3.38	1.05	-0.320	-0.363	0.44
26. Does your child exercise self-control under difficult circumstances? ^b	3.0	2.49	0.90	0.149	-0.055	0.47
27. Does your child understand when permission is needed and the right person to ask for it? ^b	3.0	3.31	0.99	-0.377	-0.123	0.49
28. Does your child deal in a constructive way with being teased? ^a	2.0	2.22	0.94	0.301	-0.689	0.41
29. Does your child stay out of situations that might get him/her in trouble? ^a	3.0	3.24	1.05	-0.237	-0.418	0.41
30. Does your child accept the consequence of her/his behavior? ^b	3.0	2.91	1.02	-0.052	-0.506	0.42
31. Does your child help arrive at a plan that satisfies both him/herself and others who have taken different positions (i.e., negotiates)? ^a	3.0	2.51	0.96	0.127	-0.402	0.55
32. Does your child express an honest complement to others about how they played a game? ^b	3.0	2.54	1.03	0.113	-0.647	0.54
33. Does your child deal positively with being left out of some activity? ^a	2.0	2.32	0.93	0.332	-0.222	0.37
34. Does your child maintain eye contact when talking with others?	3.0	2.65	1.03	0.151	-0.375	0.47
35. Does your child wait his/her turn to talk (without interrupting)?	2.0	2.24	0.90	0.316	-0.210	0.43
36. Does your child express her/his thoughts and concerns without complaining or whining?	3.0	2.76	0.96	-0.053	-0.391	0.40
37. Does your child have discussions with others without sharing information that is unrelated to the topic at-hand?	3.0	2.50	0.86	-0.012	-0.143	0.33
38. Does your child have discussions without running on about a specific topic?	2.0	2.39	0.89	0.218	-0.219	0.37
Total score	105.0	104.36	18.69	-0.201	-0.059	

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^aIndicates exact item from Skillstreaming curriculum (Goldstein et al. 1997; McGinnis and Goldstein 1997)

^bIndicates item adapted from the Skillstreaming curriculum (Goldstein et al. 1997; McGinnis and Goldstein 1997). Other items created by Lopata and Thomeer (Lopata et al. 2008)

Table 3 Validity correlations between ASC total and child characteristics, SRS-2, and BASC-2/3

Variable/scale	<i>r</i> (<i>p</i>)
Child characteristics	
Age (years)	0.026 (0.67)
WISC-IV IQ	−0.063 (0.30)
CASL	
Short-form expressive language	−0.008 (0.59)
Short-form receptive language	0.000 (0.99)
SRS-2	
Total score	−0.69 (<0.001)
Social communication and interaction (SCI)	−0.72 (<0.001)
Restricted interests and repetitive behavior (RRB)	−0.41 (<0.001)
BASC-2/3 PRS	
Adaptive skills composite	0.75 (<0.001)
Adaptability scale	0.55 (<0.001)
Social skills scale	0.64 (<0.001)
Leadership scale	0.57 (<0.001)
Activities of daily living scale	0.47 (<0.001)
Functional communication scale	0.54 (<0.001)
Externalizing problems composite	−0.45 (<0.001)
Hyperactivity scale	−0.46 (<0.001)
Aggression scale	−0.40 (<0.001)
Conduct problems scale	−0.29 (<0.001)
Developmental social disorders content scale	−0.67 (<0.001)

All calculations based on *N*=275 parent ratings

WISC-IV Wechsler Intelligence Scale for Children-Fourth Edition, *CASL* Comprehensive Assessment of Spoken Language, *SRS-2* Social Responsiveness Scale, Second Edition, School Age Form, *BASC-2/3 PRS* Behavior Assessment System for Children, Second/Third Edition Parent Rating Scales

with that reported by Lopata et al. (2008, 2010). Skewness and kurtosis indices were good across the items and for the total score. In addition, item total correlations were generally moderate for each item (ranging from 0.30 to 0.66). Together, these results provide support for the internal consistency of the 38 individual items and the total score. Stability of the ASC was assessed for two separate intervals and subsamples using both linear correlations (Pearson *r*) and ICCs. Results of the 6-week test–retest interval indicated very good stability (Pearson *r*=.81 and ICC=0.78). Over the 9-month test–retest interval, stability was somewhat lower but continued to be good (Pearson *r*=.63 and ICC=0.64).

Before examining criterion-related validity against other skill and symptom scales, the ASC total score was examined for its relationship to age, IQ, and language levels. Correlations were nonsignificant and negligible suggesting that the skills and behaviors assessed by the ASC operated relatively independent of those child variables for this

sample of 6–12 year olds with HFASD. A similar lack of association has been noted in other studies of youth with HFASD assessing the relationship between adaptive skills (including social skills) and age and IQ (e.g., Kenworthy et al. 2010; McDonald et al. 2017). Criterion-related validity was assessed via associations between the ASC total score and scales measuring ASD-related symptoms and impairments, prosocial skills, and behavior regulation problems. Comparisons between the ASC and scales measuring ASD-related symptoms and impairments yielded significant inverse relationships (SRS-2 and BASC-2/3 DSD). Specifically, as ratings on the ASC (prosocial and adaptive skills) increased, ratings of ASD-symptom severity decreased. Further, the magnitudes of the relationships between the ASC and the SRS-2 total score and DSD were very similar (−0.69 and −0.67, respectively). Closer examination of the relationship between the ASC and SRS-2 scales indicated a stronger relationship between the ASC and the social/social-communication scale (SCI) scores than the circumscribed and repetitive behaviors/interests scale (RRB) scores. This was not surprising as the large majority of ASC and SRS-2 items assess social/social-communication skills and symptoms, respectively.

Beyond their association with ASD symptoms, ASC scores were compared to prosocial adaptive skills and behavior regulation problems ratings on the BASC-2/3. The pattern of findings was consistent and indicated significant positive associations, of moderate-to-high magnitude, with the adaptive skills ratings. Examination of the individual adaptive scales indicated that the strongest association was between the social skills scale and the ASC (0.64). This was anticipated because of the large number of items on the ASC assessing social/social-communication skills. Given that the ASC items also assess behavioral regulation and adaptive coping without engaging in ASD-related behaviors (e.g., uses self-control, has conversations without running on about a circumscribed interest, etc.), the ASC scores were also compared to the externalizing scales of the BASC-2/3. Across the scales, significant (small-to-moderate) negative correlations indicated that as ASC ratings increased problem behavior ratings decreased. Overall, results of the comparisons with the SRS-2 and BASC-2/3 scales provided support for criterion-related validity of the ASC as an indicator of prosocial and behavior regulation skills.

These initial findings supporting the properties of the ASC are promising, particularly as the ASC has previously shown treatment sensitivity. This is important because the psychosocial interventions for which it has been used have relied heavily on social skills groups which are widely used in schools and clinical settings (Koenig et al. 2009) and they employ similar instructional protocols (i.e., direct instruction, modeling, role-play/rehearsal, and performance

feedback; Kaat and Lecavalier 2014; Reichow et al. 2012). In addition, the ASC includes many items that assess skills targeted in the Skillstreaming curriculum (Goldstein et al. 1997; McGinnis and Goldstein 1997) which is commercially available and has been found effective and/or considered useful for youth with HFASD (e.g., Kaat and Lecavalier 2014; Thomeer et al. 2016). The current study also examined the properties of the ASC for the critical informant group of parents. Although questions have been noted about the reliability of parents as raters (Reichow et al. 2012), the current results supported the internal consistency of their ratings, and stability over 6-week and 9-month intervals.

The current study provides important information on the psychometric properties of the ASC however several limitations warrant mention and provide direction for future studies. As this was the first study to test the reliability and criterion-related validity of the ASC for children with HFASD using a large sample of parent ratings, additional psychometric studies are needed. This study utilized the total ASC score for the analyses and, as such the estimates were interpreted within that parameter (Lord et al. 2014). Additional studies using sufficiently large sample sizes are recommended to determine the possible presence of subscales within the ASC (i.e., exploratory factor analyses). Other psychometric studies utilizing item response theory and testing the capacity of the ASC to discriminate between children with HFASD and non-HFASD children (e.g., typically-developing, other clinical diagnosis) will provide important information on the properties and clinical utility of the ASC. An additional limitation involved the testing of parent ratings only. Though parents are considered critical sources of information, teachers constitute another key informant group (Norris and Lecavalier 2010). Ratings from multiple informants including parents and teachers provide important information on functioning across settings; as such additional studies of the psychometric properties of teacher ratings, as well as informant discrepancies are needed (Achenbach 2011). Lastly, the nature of the child sample constituted both a study strength and limitation. The narrowly-defined and relatively homogeneous sample helped minimize the confounding of the results because functional level can affect the properties of an instrument. Despite this strength, the sample was overwhelmingly Caucasian and lacked diversity. Recent research has indicated that a large majority of basic and intervention studies involving ASD samples have failed to report the race or ethnicity of the participants, and when reported the samples have been predominantly Caucasian (Pierce et al. 2014; West et al. 2016). In addition, research suggests that children with ASD from diverse backgrounds (i.e., Latino and African-American) receive fewer friendship nominations relative to a comparison group of

Caucasian children with ASD (Azad et al. 2017). Overall, the functional-homogeneity and lack of diversity of the sample limits the generalizability of the results to the characteristics of the sample. Future studies should examine the properties of the ASC within different age and functional level samples of youth with ASD, as well as within more diverse samples with ASD.

While instruments often measure the absence of skills and/or presence of abnormalities (Lord et al. 2014), the ASC assesses ASD-related dimensions in terms of prosocial skills and positive behavior and interest regulation. Initial indications from this study suggest that it possesses good properties for parent ratings of 6–12 year olds with HFASD and prior studies suggest that it is treatment sensitive for this group of children. Ongoing studies will help further define the psychometric properties of the ASC.

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Author Contributions CL conceived of the study, participated in its design, developed the scale items, and drafted the manuscript; JDR contributed to the study design, managed and coordinated the data, and contributed to manuscript preparation; JPD participated in the design, conducted the statistical analyses, and assisted in the interpretation of the data and preparation of the manuscript; MLT developed the scale items, and participated in the study design and manuscript preparation; CAM participated in the study design, assisted with data coordination, and contributed to manuscript preparation; MAV participated in the study design and contributed to manuscript preparation. All authors read and approved the final manuscript.

Compliance with Ethical Standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical Approval All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed Consent Informed consent was obtained from all participants included in this study.

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